Naval Surface Warfare Center
Carderock Division
West Bethesda, MD 20817-5700

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Survivability, Structures, and Materials Directorate

Technical Report

Identification of Welldeck Washout Discharge Constituents: Summary Report

by

Mary L. Wenzel
Naval Surface Warfare Center, Carderock Division

James D. Surgeon
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Section 325 of the 1996 National Defense Authorization Act, "Discharges from Vessels of the Armed Forces," requires the Navy to comply with Uniform National Discharge Standards (UNDS) to control the overboard discharge of incidental wastewaters from ships of the Armed Forces. During Phase I of the UNDS initiative, it was determined that welldeck washout discharges requires a Marine Pollution Control Device (MPCD) to control the discharge.

At the request of Naval Sea Systems Command (NAVSEA 05L13), representatives from Naval Surface Warfare Center, Carderock Division; Puget Sound Naval Shipyard; and AMSEC LLC, conducted shipboard assessments to identify constituents that have the potential to contribute to welldeck washout. The shipboard assessment team conducted three consecutive at-sea assessments aboard a LHD-1 class amphibious assault ship, LPD-4 class amphibious transport dock ship, and LSD-49 class dock landing ship. The ships were conducting a Special Operations Capable Exercise (SOCEX) and had a full complement of embarked troops, their vehicles and equipment. While aboard the ships, the team observed and documented processes performed in the welldeck, including ballasting and deballasting, and craft launch and recovery. The team interviewed ship's force and Marine personnel to obtain information on processes and equipment that have the potential to contribute to welldeck washout discharges. The data obtained during the assessments will be used to develop the MPCD for welldeck washout discharges

The assessment team identified several marine pollution control devices currently in use, including: FOD (foreign object damage) walkdowns conducted prior to launching and recovering landing craft air cushioned vehicles; ships crew training to provide rapid spill response; hose connection adapters installed in both the stern gate and the landing craft, utility (LCU) to enable the craft to discharge collection, holding and transfer tank effluent (sewage) and graywater outside 3 nm; a fueling nozzle adapter installed in the LCU to allow the Carter aircraft underwing fueling nozzle to be used during fueling evolutions; the LCU crew instruction, *"LCU Safety Precautions and Refueling Checklist"*; assault amphibian vehicles relocated from the welldeck to the vehicle storage area to perform emergency maintenance; and old fueling hoses placed under the tracks to prevent abrasion when moving tracked vehicles on and off the LCU. In addition, one ship is a test platform for the edge retentive, chemical and heat resistant coating, Sigma Edgeguard™. This coating was applied to the welldeck overhead and is expected to eliminate maintenance for 10 years.

As a result of the excellent environmental conditions observed in the welldecks, the team was unable to identify equipment or best management practices, other than those currently in place, to serve as potential MPCDs. However, the Welldeck Control Officer of the ship testing Sigma Edgeguard™ requested the coating be considered as a potential MPCD for not only welldeck overheads, but the entire welldeck and vehicle storage areas. These areas are subject to a high degree of corrosion: e.g., the entire welldeck from the saltwater spray and high temperature exhaust from landing craft air cushioned vehicles; the vehicle storage areas from seawater washdowns conducted prior to Department of Agriculture inspections.

The shipboard assessment team found that the welldecks of all three ships were extremely clean due to the proactive and precautionary measures taken by ships force to ensure the ship achieves and maintains environmental compliance. Only negligible amounts of contaminants potentially could, under certain conditions, enter surrounding waters. These amounts are so insignificant, the team recommends they not be considered when performing cumulative impact analysis calculations.

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ADMINISTRATIVE INFORMATION

The resource sponsor for Uniform National Discharge Standards Development Program is Chief of Naval Operations, N452. The Research Development Test and Evaluation Program Manager is C. Adema, Naval Sea Systems Command, SEA 05R24. This project is described in the Naval Surface Warfare Center Carderock Division, Research and Technology Work Unit Summary 6310-282. This task was supported by AMSEC LLC, as delineated in Technical Instructions 2R2-733A and 2R2-670A of Contract N00024-96-C-409.

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EXECUTIVE SUMMARY

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INTRODUCTION

Uniform National Discharge Standards.

On 10 February 1996, President Clinton signed into law the Fiscal Year 1996 National Defense Authorization Act. Section 325 of the Authorization Act, "Discharges from Vessels of the Armed Forces," requires the Department of Defense and the Environmental Protection Agency (EPA) to jointly develop Uniform National Discharge Standards (UNDS) for wastewater discharges, other than sewage, incidental to the normal operation of a vessel of the Armed Forces. The Act applies to discharges for which it is reasonable and practicable to require the use of a Marine Pollution Control Device (MPCD) to mitigate adverse impacts on the marine environment. The intent of the Act is to establish a consistent set of vessel effluent standards that enhances environmental protection and provides the Armed Forces with mission-related operational flexibility.

Naval Sea Systems Command (NAVSEA 05L13) and EPA have conducted equipment expert meetings with cognizant life cycle managers and equipment experts to gain knowledge on equipment operation and to identify additional information required to evaluate each discharge. In addition, NAVSEA and EPA performed nature of discharge analyses and determined that welldeck washout discharges have the potential for causing an adverse environmental effect. Preliminary practicability analyses showed that at least one reasonable and practicable MPCD exists. As a result, NAVSEA and EPA determined that welldeck washout discharges will require an MPCD.

BACKGROUND

Welldeck Washout Discharges.

Amphibious assault ships have a docking well, or "welldeck" in the aft section of the ship for embarking, storing, and disembarking amphibious landing craft. The welldeck is a rectangular area that is approximately 40 to 78 ft. wide, 168 to 440 ft. long, and 20 to 30 ft. high. The ship submerges the welldeck by ballasting, i.e., flooding clean ballast tanks with seawater. Welldeck washout occurs when the welldeck has been flooded to embark or disembark landing craft for amphibious landing operations. When the welldeck is submerged, constituents that may be present in the welldeck are mixed with seawater and eventually flow to the open sea.

The amount of water taken into the welldeck is dependent on the type of landing craft being embarked or disembarked. For example, ships carrying landing craft air cushioned vehicles and assault amphibian vehicles ballast-down to a maximum water depth of one ft. at the stern gate sill to launch the craft. When recovering the craft, the ship ballast-down to a maximum depth of one ft. for landing craft air cushioned and four ft. for assault amphibian vehicles. When the ship is launching landing craft utility vehicles, the ship must ballast-down to a water depth of eight feet at the stern gate sill. When the ship deballasts, approximately 7,000 to over 1,000,000 gallons of water, depending on ship class, washes out of the welldeck into surrounding waters; thus the term "welldeck washout". Because landing craft are normally embarked or disembarked

within 12 nautical miles (nm) of shore, discharges associated with their launch and recovery are subject to UNDS.

Sources of contaminants that may be present in welldeck washout include materials used to maintain equipment housed in the welldeck. There are four primary sources which contribute to welldeck washout: (1) washout from the welldeck when the ship ballasts to embark or disembark landing craft; (2) graywater and cooling water discharged from LCU vehicles; (4) freshwater used to remove salt and dirt from vehicles, equipment and landing craft; and (5) U.S. Department of Agriculture washes of the welldeck, vehicle storage areas, and all vehicles, equipment, and landing craft. Since amphibious assault training operations are typically conducted within the contiguous zone (0 – 12 nm), welldeck washout discharges occur anywhere from within the harbor to at-sea.

Amphibious Readiness Groups[1].

The mission of the Amphibious Ready Group (ARG) is to plan and execute amphibious operations and training with assigned ships to ensure the highest state of efficiency, morale, material readiness and to maintain maximum readiness for war. It combines combat strength with mobility in order to deter aggression, conduct amphibious operations and render humanitarian assistance.

The ships and personnel assigned to amphibious squadrons combine to create an ARG. The ARG usually consists of a multi-purpose amphibious assault ship (LHD/LHA), a amphibious transport dock ship (LPD) and a dock landing ship (LSD). A Marine Expeditionary Unit and their equipment embark aboard ARG ships.

A Marine Expeditionary Unit[2] (MEU) is the smallest type of Marine air-ground task force. They are an expeditionary intervention force with the ability to rapidly organize for combat operations in virtually any environment. The mission of the MEU is to fulfill routine forward deployments with fleets in the Mediterranean, the Western Pacific, and periodically, the Atlantic and Indian Oceans. The MEU is deployed as a complement of an ARG on up to four Naval amphibious assault ships. Vehicles and equipment typically brought onboard ship to support amphibious assault operations include: landing craft air cushioned vehicles; landing craft, utility; assault amphibian vehicles; light armored vehicles; high mobility multipurpose wheeled vehicles, tanks, jeeps, trucks, motorcycles, howitzers, and trailers.

With a strength of about 2,200 personnel, the MEU is normally built around a reinforced battalion, aircraft squadron, and a service support group. The MEU brings all the supplies it needs to sustain itself for quick mission accomplishment or to pave the way for any follow-on forces.

Amphibious Vehicle Description and Operation.

The shipboard assessment team observed and documented processes related to the amphibious vehicles carried onboard the LHD-1, LPD-4 and LSD-49 class ships. Pictures showing the vehicles are provided as Appendices A and B.

Lighter, Amphibious, Resupply, Cargo Vehicle. The Lighter, Amphibious, Resupply, Cargo Vehicle (LARC), was designed to carry cargo or troops from ships offshore to the beach or further inland. The vehicle is 30 feet long and manned by a crew of three.

Assault Amphibian Vehicle[3]. The Assault Amphibian Vehicle (AAV), is an armored assault amphibious full-tracked landing vehicle. The vehicle carries troops in water operations from ship-to-shore. It also carries troops to inland objectives ashore. AAVs are 13½ feet long, 6 feet wide, manned by a crew of four, and can carry 12 – 25 troops.

High Mobility Multipurpose Wheeled Vehicles[3]. High Mobility Multipurpose Wheeled Vehicles (HMMWVs), provide a variety of wheeled vehicle platforms. They can function as a cargo and troop carrier, armament carrier, missile system carrier, shelter carrier, and as a ambulance. The vehicles are 15 feet long, 7 feet wide, and are typically manned by a crew of four, depending on HMMWV configuration.

Landing Craft Air Cushioned[4]. Landing Craft Air Cushioned (LCAC) vehicles, are used to transport personnel, weapons and cargo from ship-to-shore and across the beach. The LCAC is a high-speed, over-the-beach fully amphibious landing craft capable of carrying a 60 – 70 ton payload. The air cushion allows this vehicle to reach more than 70 percent of the world's coastline, while conventional landing craft can land at only 15 percent of the coasts.

LCAC vehicles are 88 feet long and have a 47 ft. beam. Each LCAC is manned by a crew of five Navy personnel: a craft master, craft engineer, navigator, deck engineer and load master. Each LCAC typically carries 26 embarked troops; however, if the passenger transport module is installed, it can transport 140 additional troops. The craft masters stated that the LCACs are always operated within the contiguous zone except during an extended deployment.

Landing Craft, Utility[4]. Landing Craft, Utility (LCU), are used by amphibious forces to transport equipment and troops to the shore. They have a bow and stern ramp for onload/offload at either end. The craft are 135 feet long, 29 feet wide, and manned by 11-14 Navy personnel, including: craft master, chief engineer, navigator, communications, electrician, cook, boatswain's mate, seaman, and 3 – 6 troops.

Light Armored Vehicle-25[3]. The Light Armored Vehicle (LAV) 25, is an all-terrain, all-weather vehicle with night capabilities. They provide strategic mobility to reach and engage the threat, tactical mobility for effective use of fire power, fire power to defeat soft and armored targets, and battlefield survivability to carry out missions. The LAV-25 is 21 feet long and 9 feet wide. The vehicle is manned by a driver, gunner, and commander, and can carry 6 troops.

Ships Mission.

LHD-1 Class. LHD-1 class amphibious assault ships are 844 feet in length and manned by a crew of approximately 1,100 ships force and 1,700 embarked Marines. The ship's mission is to perform as a primary landing ship for assault operations conducted by Marine Expeditionary Units. LHD-1 class ships use LCAC vehicles, conventional landing craft and helicopters to transport Marine assault forces ashore. In a secondary role, these ships perform sea control and limited power projection missions using AV-8B Harrier aircraft and anti-submarine warfare helicopters.

LPD-4 Class. LPD-4 class amphibious transport dock ships are 570 feet in length and manned by a crew of approximately 420 ships force, 75 Flag complement personnel and 825 embarked Marines. The ship's mission is to transport and land Marines, their equipment and supplies by embarked landing craft or amphibious vehicles augmented by helicopters in an amphibious assault.

LSD-49 Class. LSD-49 class dock landing ships are 610 feet in length and manned by a crew of approximately 350 ships force and 500 embarked Marines. The ships mission is to project power ashore by transporting and launching amphibious craft and vehicles loaded with embarked Marines and their equipment in an amphibious assault. The ship can also render limited docking and repair service to small ships and craft, as well as act as the primary control ship in an amphibious operation.

APPROACH

NAVSEA (05L13) established a three-person shipboard assessment team, comprised of representatives from the following organizations: (1) Naval Surface Warfare Center, Carderock Division (NSWCCD); (2) Puget Sound Naval Shipyard (PSNS); and (3) AMSEC LLC.

The shipboard assessment team conducted consecutive at-sea assessments aboard a LHD-1 class amphibious assault ship, LPD-4 class amphibious transport dock ship, and LSD-49 class dock landing ship during a Special Operations Capable Exercise (SOCEX) conducted within the contiguous zone. During the SOCEX, each ship had a full complement of embarked troops, their vehicles and equipment. The welldeck of each ship was configured with the same vehicles and craft as it will be during their impending six-month deployment. .

The team characterized the discharge by assessing welldeck processes, equipment and operations, and by interviewing the ship's crew and MEU personnel while they were engaged in normal operations in the welldeck.

Two surveys were developed for use during the shipboard assessments: a baseline survey and a class-specific survey. The baseline survey was designed to obtain information common to the three ships surveyed. This information was used during each shipboard assessment and will serve as a baseline for comparison purposes when evaluating potential MPCDs. The class-specific survey was designed to obtain information related to processes that are performed in the welldeck of each class of ship.

Although the data collected apply specifically to the ships surveyed, the results are considered representative of other amphibious assault ships.

RESULTS

Operational Zones.

The ships' operational zones and the percentage of time spent in each zone for the preceding two years are shown below.

LHD-1 Class.

Location	Previous 12 Months	Previous 12-24 Months
Pierside	70%	50%
At-Sea	30%	50%

Amount of above at-sea time spent operating within:

Location	Previous 12 Months	Previous 12-24 Months
0-3 nm	4%	3%
3-12 nm	70%	49%
>12 nm	26%	48%

LPD-4 Class.

Location	Previous 12 Months	Previous 12-24 Months
Pierside	84%	54%
At-Sea	16%	46%

Amount of above at-sea time spent operating within:

Location	Previous 12 Months	Previous 12-24 Months
0-3 nm	27%	9%
3-12 nm	28%	13%
>12 nm	45%	78%

LSD-49 Class.

Location	Previous 12 Months	Previous 12-24 Months
Pierside	60%	25%
At-Sea	40%	75%

Amount of above at-sea time spent operating within:

Location	Previous 12 Months	Previous 12-24 Months
0-3 nm	50%	30%
3-12 nm	25%	15%
>12 nm	25%	55%

Typical Operational Scenario.

The types of operations conducted within each of the operating areas are as follows:

LHD-1 Class.

Operating Zone	Typical Operational Scenario
0-3 nm	Transit, AAV and LCAC operations, rotary wing flight operations
3-12 nm	Transit, LCAC operations, rotary wing flight operations
> 12 nm	Transit, rotary and fixed wing flight operations, LCAC operations

LPD-4 Class.

Operating Zone	Typical Operational Scenario
0-3 nm	Transit, LCU and AAV operations, rotary wing flight operations
3-12 nm	Transit, LCU operations, rotary wing flight operations
> 12 nm	Transit, LCU operations, rotary and fixed wing flight operations

LSD-49 Class.

Operating Zone	Typical Operational Scenario
0-3 nm	Transit, LCAC and AAV operations, rotary wing flight operations
3-12 nm	Transit, LCAC operations, rotary wing flight operations
>12 nm	Transit, LCAC operations, rotary wing flight operations

Ballasting/Deballasting Operations.

Amphibious assault ships ballast-down in order to launch and recover amphibious vehicles. The depth to which the ship ballast-down is dependent on the type of craft being launched or recovered. As shown in Appendices C and D, when the ship is ballasted-down, the aft end of the ship sits lower in the water than the forward end, thus creating varying water depths within the welldeck, i.e., there is more water at the stern gate than at the forward end of the welldeck. The team did not observe a sheen during the numerous ballasting and deballasting operations they observed.

LHD-1 Class. LHD-1 class ships normally carry three landing craft air cushioned vehicles. Prior to LCAC launch and recovery, ships force perform a "FOD (foreign object damage) walkdown", Appendix E, to remove debris from the welldeck that could become drawn into the craft's engines and result in a catastrophic engine failure. When recovering or launching LCACs, LHD-1 class ships can either maintain a dry well or ballast-down to a depth of 6 inches at the stern gate sill. Due to the angle that is created when the ship ballast-down, nearly all of the

welldeck remains dry. When launching and recovering LCACs, the stern gate is lowered to -10° below the waterline to allow the LCAC to enter or exit the dry welldeck. When the LCAC enters the welldeck, a surge of seawater and seawater spray accompanies the craft as it transits aboard, Appendix F. After all the LCACs are recovered, it is standard practice to operate the eductors to evacuate standing water. Personnel assigned to Welldeck Control stated that they have never noted a sheen on the water when the welldeck was flooded.

If the LHD-1 class is launching or recovering LCUs, the ship must ballast-down to a depth of eight feet at the stern gate sill. During the past 24 months, the LHD-1 surveyed had ballasted-down ten times to a depth of eight feet in order to launch and recover LCUs.

LPD-4 Class. The LPD-4 class ship was configured to carry one LCU and numerous AAVs. The ship must ballast-down to launch and recover both craft. When launching and recovering LCUs, the stern gate is lowered to -17° below the waterline. The ship ballast-down to a depth of eight feet at the stern gate sill which creates a depth of approximately three feet at the forward end of the welldeck. It takes approximately 40 minutes to ballast-down to a water depth of eight feet at the stern gate sill and approximately 45 minutes to deballast.

When launching or recovering AAVs, the stern gate is lowered to -10° below the waterline. The ship ballasts to a depth of one ft. at the stern gate sill to launch and four feet to recover AAVs. Due to the angle that is created when the ship ballast-down, most of the welldeck remains dry.

During the past 24 months, the LPD-4 surveyed had ballasted-down 57 times to a depth of four feet or more in order to launch and recover LCUs and recover AAVs. Personnel assigned to Welldeck Control stated that they have never observed a sheen on the water when the ship is ballasted-down

LSD-49 Class. LSD-49 class ships typically carry two LCACs. As with the LHD-1 ship, a "FOD walkdown" is conducted prior to LCAC launch and recovery. When receiving or launching LCACs, the LSD-49 class ship lowers the stern gate to -10° below the waterline and either maintains a dry well or ballasts-down to a maximum depth of six in. at the stern gate sill. When ballasted-down to a depth of six in. most of the welldeck remains dry.

The ship ballasts to a depth of one ft. to launch AAVs and four feet to recover the vehicles. If launching or recovering LCUs, the ship ballasts to a depth of ten feet at the stern gate sill.

During the past 24 months, the LSD-49 surveyed had ballasted-down 80 times to a depth of four feet or more in order to launch and recover LCUs and recover AAVs. Welldeck Control personnel stated they have never observed a sheen on the water when the welldeck is flooded.

Welldeck Structure and Condition.

The structure and condition of each ship's welldeck is as follows:

LHD-1 Class.

Welldeck Structure. The welldeck of the LHD-1 class ship is 267 feet long and 50 feet wide, Appendix G. The deck (floor) of the welldeck is covered with 2 in. thick pressure treated douglas fir wood planks secured by bolts. The forward section of the welldeck contains a 12 ft. long stainless steel grating that extends the width of the welldeck; this area is referred to as the "false beach". Immediately behind the false beach is a stainless steel ramp leading to the vehicle storage areas. Interspersed throughout the deck are 300 tie-down points, Appendix G, used to secure the craft to the deck. Eight 2-in. wide yellow lines that form the outline of a large (3 feet x 6 feet) rectangle are painted on the deck. Also painted on the deck is one 24-in. wide white line the full length of the welldeck. These lines are used by the craft masters to position the craft as they are recovered.

Four 125 gpm water eductors are located next to the bulkhead (wall) at all four corners of the welldeck. The bulkheads are lined with pressure treated douglas fir wooden batter boards and 4 ft. high stainless steel bumpers spaced 4 feet apart (49 bumpers on each side). The aft 65 ft. section of the bulkhead is covered with synthetic batter boards. All metals surfaces are painted gray, except for the tie-downs which are painted red.

The welldeck contains a narrow catwalk on both sides that extends the full length of the 01 level of the welldeck. There are firemain connections as well as connections for JP-5, diesel fuel, and potable water in compartments accessed from the catwalk. The welldeck overhead (ceiling) contains lighting, and ventilation and monorail systems

A 20 ft. high stern gate, located at the aft end of the welldeck, is hydraulically raised and lowered, Appendix H, to allow craft ingress and egress. The stern gate can be secured in heavy seas using the in-place stainless steel locking devices. Immediately above the stern gate is a hydraulically operated "eyebrow" that opens and closes. Although the stern gate is capable of being lowered to -17° below the waterline, it is normally lowered to -10° when launching or recovering LCAC vehicles.

Welldeck Condition. The assessment team had the opportunity to visually observe the condition of the empty welldeck prior to craft onload. The decks and bulkhead were in excellent condition; no stains or visible contaminants were noted. The overhead of the welldeck contained rust caused by the corrosive environment created by the LCACs. When the LCAC enters the ship, saltwater and sand entrained in the air vortex under the "skirt" of the LCAC are transported onboard ship. A mist of seawater is propelled onto the deck, overhead and bulkhead by the high-speed turbine engines and "baked" onto the surfaces by the LCACs high temperature exhaust.

LPD-4 Class.

Welldeck Structure. The welldeck of LPD-4 class ships is 163 feet long and 50 feet wide, Appendix I. The deck is covered with 2 in. thick pressure treated douglas fir wood planks secured by bolts covered with caulking to prevent corrosion. Interspersed throughout the deck are 160 tie-down points, Appendix I, used to secure the craft to the deck. The tie-down points are different from those observed on the LHD-1 and the same as those on the LSD. On the deck next to the bulkhead are six gravity-fed open drains (three on each side) located 55 feet, 105 feet, and 125 feet from the stern gate. Ninety feet from the stern gate is a 6 ft. wide "water brake" designed to minimize wave action to protect the vehicles in the forward end of the welldeck; however, the crew stated the water brake is not effective, so it is not used. At the forward end of the welldeck is the "false beach", a 10 ft. long section of wood grating that extends the entire width of the welldeck. Immediately behind the wood grating is a 15 ft. long metal grating and a metal ramp that lead to the vehicle storage areas. As with the other ships, a 24 in. wide white line is painted on the deck the full length of the welldeck to aid in positioning the craft as they are recovered.

The lower four feet of the bulkhead is covered with painted metal sheathing. Above the sheathing are painted douglas fir wooden batter boards. All painted surfaces are gray, including the tie-downs.

The welldeck contains a narrow catwalk on both sides that extends the full length of the welldeck. There are firemain connections as well as connections for JP-5, diesel fuel, and potable water in a compartment accessed from the catwalk. The welldeck overhead (ceiling) contains lighting, and ventilation and monorail systems

A 20 ft. high stern gate, located at the aft end of the welldeck, is hydraulically raised and lowered to allow craft ingress/egress. Immediately above the stern gate is a hydraulically operated "eyebrow" that opens and closes. The crew has installed a hose connection adapter to an access cover, Appendix J, located immediately above the deck in the middle of the stern gate to enable graywater and collection, holding and transfer (CHT) tank wastewater effluent from the LCU to be discharged outside 3 nm.

Welldeck Condition. When the assessment team boarded the ship, the welldeck contained a full complement of vehicles and equipment. As a result the team was unable to observe and document the entire deck. The deck showed signs of wear, i.e., splintered and missing pieces of wood. This wear was more pronounced at the forward end of the welldeck and was caused by tracked assault amphibian vehicles traversing the deck. No stains or visible contaminants were noted. The team observed the condition of the welldeck immediately after deballasting and noted that sand and rocks were carried onto the deck when the LCU was recovered.

LSD-49 Class.

Welldeck Structure. The welldeck of LST-49 class ships is 184 feet long and 40 feet wide, Appendix K. Unlike the LHD and LPD, the LSD has a removable flight deck. As a result, sections of the welldeck at the 01 level are open to the exterior weather decks. The deck is covered with 2 in. thick pressure treated douglas fir wood planks secured by bolts covered with caulk to prevent corrosion. Interspersed throughout the deck are 178 tie-down points used to secure craft to the deck. The tie-down points are the same as those on the LPD-4 class ship. On the deck next to the bulkhead are two gravity-fed open drains on each side; the drains are located at 10 feet and 110 feet from the stern gate. At the forward end of the ramp, approximately 190 feet from the stern gate, is a diesel fuel marine station. The "false beach" at the forward end of the welldeck contains a 20 ft. long section of metal grating that extends the entire width of the welldeck. Immediately behind the grating is a metal ramp that lead to the vehicle storage areas. As with the LHD and LST, a 24-in. wide white line is painted on the deck the full length of the welldeck to aid in positioning craft as they are recovered.

The bulkheads are lined with pressure treated douglas fir wooden batter boards and 4 ft. high stainless steel bumpers spaced 4 feet apart (32 bumpers on each side). The aft 95 feet of the bulkhead is covered with synthetic batter boards. All metals surfaces are painted gray, including the tie-downs.

The welldeck overhead contains lighting, a ventilation system, and a single monorail system. The overhead is coated with the edge retentive, chemical and heat resistant coating, Sigma Edgeguard™. This coating was applied on a test basis one year ago and is expected to eliminate maintenance for 10 years. The coating showed no signs of deterioration or rust. The Welldeck Control Officer recommended the coating be considered as a potential MPCD for not only welldeck overheads, but the entire welldeck and vehicle storage areas. These areas are subject to a high degree of corrosion: the entire welldeck from the saltwater spray and high temperature exhaust from landing craft air cushioned vehicles, and the vehicle storage areas from seawater washdowns conducted to prepare for Department of Agriculture inspections.

The welldeck contains a narrow catwalk on both sides that extends the full length of the 01 level of the welldeck. There are firemain connections as well as connections for JP-5, diesel fuel, and potable water in compartments accessed from the catwalk.

The LSD has a 20 ft. high stern gate located at the aft end of the welldeck. The stern gate is hydraulically raised and lowered, to allow craft ingress/egress. The stern gate can be secured in heavy seas using the in-place stainless steel locking devices. Immediately above the stern gate is a hydraulically operated "eyebrow" that opens and closes. Although the stern gate is capable of being lowered to -17° below the waterline, it is normally lowered to -10° when embarking or disembarking LCAC vehicles.

Welldeck Condition. The shipboard assessment team was provided the opportunity to observe and document the empty welldeck. The deck showed signs of wear, i.e., splintered

and missing pieces of wood. This wear was more pronounced at the forward end of the welldeck and was caused by tracked assault amphibian vehicles traversing the deck. No stains or visible contaminants were noted.

Vehicles in the Welldeck.

LHD-1 Class Ship. The LHD-1 class ship had three LCAC vehicles in the welldeck. Each LCAC carried the following vehicles:

LCAC #1: 4 LAVs
3 HMMWVs

LCAC #2: 4 LAVs
3 HMMWVs

LCAC #3: 11 HMMWVs

LPD-4 Class Ship. The LPD-4 class ship had one LCU and four AAVs in the welldeck. The LCU carried a LARC, bulldozer, tram forklift, 5-ton truck, and four HMMWVs.

LSD-49 Class Ship. The LSD-49 class ship had two LCAC vehicles in the welldeck. The assessment team was unable to accurately identify the types of vehicles on the LCAC because different equipment was continuously being on/offloaded. In addition, the team was unable to speak with the craft master to discuss vehicle load-out due to the intense operational schedule.

Processes Performed in the Welldeck.

The assessment team discussed welldeck processes with personnel responsible for operating and maintaining the equipment. The following information was obtained.

LHD-1 Class Ship.

Landing Craft Air Cushioned Vehicles. All routine maintenance is performed at a shore-based facility. When the craft are deployed onboard ship, the engines are started twice a week for operational system checks. The craft master of each vehicle indicted that although the engines are required to be cleaned with MIL-C-85704 *Cleaning Compound, Turbine Engine Gas Path (El Dorado)* every 25 hours of engine operating time, the craft are operated so infrequently when embarked (including six-month deployments) that they have never performed this maintenance in the welldeck during their three years as craft masters. A small amount of DOD-G-24508 grease used to lubricate the pedestal bearing is the only exposed maintenance material on the LCAC. Although this grease is exposed to the environment and a portion could potentially wash-off when the LCAC is rinsed, the material would have to traverse the LCAC and the welldeck deck prior to being educted overboard. The assessment team and craft masters concluded that the amount that could potentially enter surrounding waters is negligible.

Although the craft can use either jet fuel or diesel fuel marine, the ship typically refuels the craft with diesel fuel marine. This fueling evolution takes place in the welldeck. The assessment team did not have the opportunity to observe a refueling evolution; however, all three craft masters stated they have not experienced a fuel spill in their three years as craft masters. Since LCAC vehicles are equipped with the Carter aircraft underwing fueling nozzle, the team concluded that there is minimal probability for a spill since the team did not detect any spillage during the numerous aircraft fueling evolutions they observed when conducting the weather deck runoff assessments. The crew maintains a bucket by the fueling probe receiver to collect any drips. Additionally, the ships force maintains a spill kit and is trained to provide rapid spill response.

The crew rinses each LCAC with fresh water shortly after embarking. This fresh water rinse is conducted using a 1½ in garden hose with a variable nozzle attached and water supplied from the ships 95 psi fresh water system. The rinse typically takes one hour with the water running the entire time. The purpose of the rinse is to remove salt deposits which are extremely corrosive to the aluminum structure of the LCAC. No detergents or cleaners are used to wash the craft. The effluent flows onto the deck and is educted overboard.

Amphibious Vehicles. The shipboard assessment team interviewed MEU personnel to identify maintenance performed on the vehicles located in the welldeck. MEU personnel stated that no maintenance is performed on vehicles when they are housed on the LCACs in the welldeck other than a twice-weekly engine checks during which vehicles are started and the engines allowed to reach normal operating temperature. The only time maintenance is performed on a vehicle in the welldeck is if a catastrophic failure is detected.

LPD-4 Class Ship.

Landing Craft, Utility. All maintenance on the LCU is performed at a shore-based facility unless a catastrophic failure occurs. If a failure occurs, since the propulsion system is interior to the craft, the contaminants will be contained and have no potential to enter the welldeck. No system operational checks are performed on the LCU when the craft is in the welldeck. No maintenance is performed on the equipment or craft carried onboard the LCU when the craft is in the welldeck.

Touch-up painting is performed in the welldeck only if the craft has been scratched during launch or recovery. When touch-up painting is required, the crew uses sandpaper to abrade the surface before applying MIL-E-24635A exterior topcoat enamel with a brush. Other surfaces that may require touch-up paint include the deck (MIL-E-24635A) and the fire station (TT-E-2784 red exterior trim enamel). The crew uses tarps to ensure the paint does not fall onto the deck.

At each end of the craft is a ramp to facilitate vehicle on/off load. The ramp is hydraulically raised and lowered using a chain (one at each end of the ramp) that is lightly greased once a year with MIL-G-23549 general purpose grease. Although this grease is exposed to the environment and a portion could potentially wash-off when the craft is rinsed, the material would have to traverse the welldeck deck prior to being discharged overboard. The

assessment team and craft master concluded that the amount that could potentially enter surrounding waters is negligible.

As with the LCAC, the LCU can burn either jet fuel or diesel fuel marine. The craft masters stated that the LPD-4 class ship always provides the LCU with jet fuel. During the assessment, the team had the opportunity to observe the crew testing a fueling adapter manufactured by ships force. The adapter allows fueling to be conducted using the same Carter aircraft underwing fueling nozzle currently used on LCACs and aircraft. Since the adapter was successfully used to fuel both tanks, the crew welded all adapter connection points to eliminate potential leakage points and will continue to fuel the LCU using the new adapter. This adapter will serve as an excellent MPCD for all LCUs.

The crew maintains an instruction titled *"LCU Safety Precautions and Refueling Checklist"* to promulgate information, procedures and requirements when refueling. A spill kit is maintained onboard the craft and the crew is trained to provide rapid spill response.

The crew rinses the LCU with fresh water after the craft has been recovered by the ship and if no operations are scheduled for three days. The fresh water rinse takes approximately one hour using a 5/8 in. garden hose at 65 gpm with water supplied by the ships fresh water system. No detergents are used.

The eleven crewmembers live aboard the LCU in the welldeck; consequently, they generate blackwater (sewage), graywater (water from drains, sinks and showers) and cooling water. LCU vehicles typically discharge their graywater and cooling water directly to the welldeck. However, the ship installed hose connection adapters in the stern gate and the LCU to enable the LCU to directly discharge collection, holding and transfer (CHT) tank effluent (sewage) and graywater outside 3 nm. The cooling water drains directly to the deck and overboard; this water is seawater drawn from the ships firemain.

Amphibious Vehicles. MEU personnel stated that no maintenance is performed on the vehicles when they are in the welldeck. If a vehicle requires emergency maintenance, the vehicle is towed to the upper vehicle storage area for maintenance. When tracked vehicles are moved on the LCU deck, the crew places old fire hoses under the tracks to prevent deck abrasion and deterioration, thus reducing the frequency of deck painting and maintenance.

LSD-49 Class Ship.

The processes performed in the welldeck of the LSD-49 class ship are identical to the processes performed in the welldeck of the LHD-1 class ship.

MARINE POLLUTION CONTROL DEVICES IN USE

During each assessment, the team identified MPCDs in use, including:

Ship Class	Marine Pollution Control Device in Use
LHD-1	• FOD walkdowns conducted prior to craft launch and recovery • Ships crew trained to provide rapid spill response
LPD-4	• Hose connection adapters installed in the stern gate and the LCU to enable the craft to discharge CHT tank effluent (sewage) and graywater outside 3 nm • Fueling nozzle adapter installed in the LCU to allow the Carter aircraft underwing fueling nozzle to be used during fueling evolutions • LCU maintains instruction *"LCU Safety Precautions and Refueling Checklist"* to promulgate information, procedures and requirements when refueling • LCU crew trained to provide prompt spill response • AAVs relocated from the welldeck to the vehicle storage area to perform emergency maintenance • Old fueling hoses are placed under the tracks to prevent abrasion when moving tracked vehicles on and off the LCU
LSD-49	• Chemical and heat resistant coating applied to welldeck overhead • Ships crew trained to provide rapid spill response

POTENTIAL MARINE POLLUTION CONTROL DEVICES

Because of the environmentally conscious operation and maintenance practices observed in the welldecks, the team was unable to identify equipment or best management practices, other than those currently in place, to serve as potential MPCDs.

The LSD-49 class ship is a test platform for an edge retentive, chemical and heat resistant coating (Sigma Edgeguard™). This coating covers the welldeck overhead and will eliminate all further maintenance for 10 years. The Welldeck Control Officer of the ship testing the coating requested it be considered as a potential MPCD for not only welldeck overheads, but the entire welldeck and vehicle storage areas. Areas subject to a high degree of corrosion and suitable for the Sigma Edgeguard™ coating are: the entire welldeck due to saltwater spray and high temperature exhaust from LCAC vehicles; and the vehicle storage areas due to seawater washdowns conducted prior to Department of Agriculture inspections.

CONCLUSIONS

The shipboard assessment team found that the welldecks of all three ships were extremely clean. Ships force aboard the LHD-1, LPD-4 and LSD-49 class ships are very proactive and take precautions to ensure the ship achieves and maintains environmental compliance. Only negligible amounts of contaminants potentially could, under certain conditions, enter surrounding waters. These amounts are so insignificant, the team recommends they not be considered when performing cumulative impact analysis calculations.

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3. U.S. Marine Corps Fact File web site: http://www.hqmc.usmc.mil/factfile.nsf/
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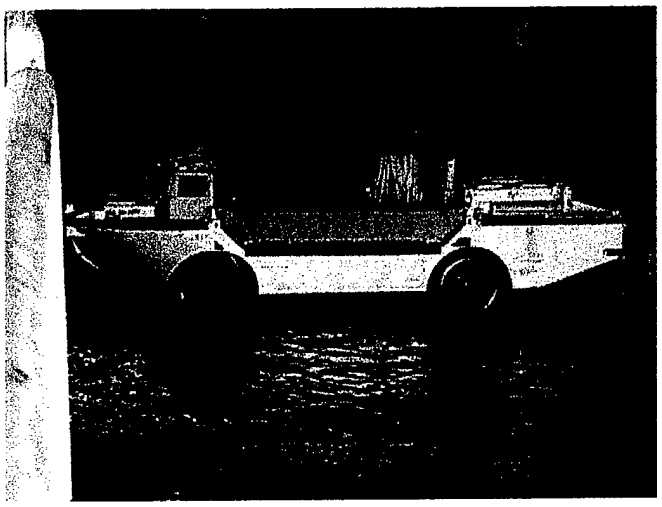
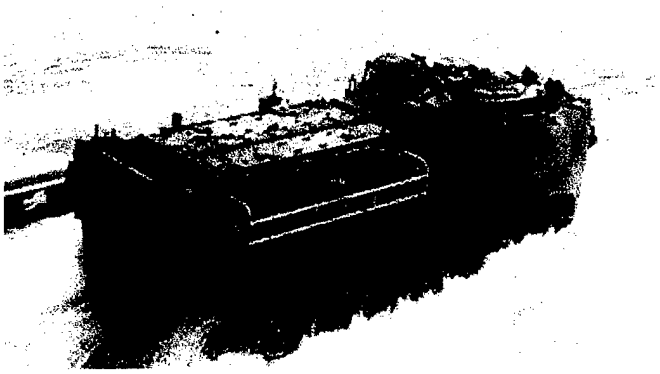
Amphibious Vehicles



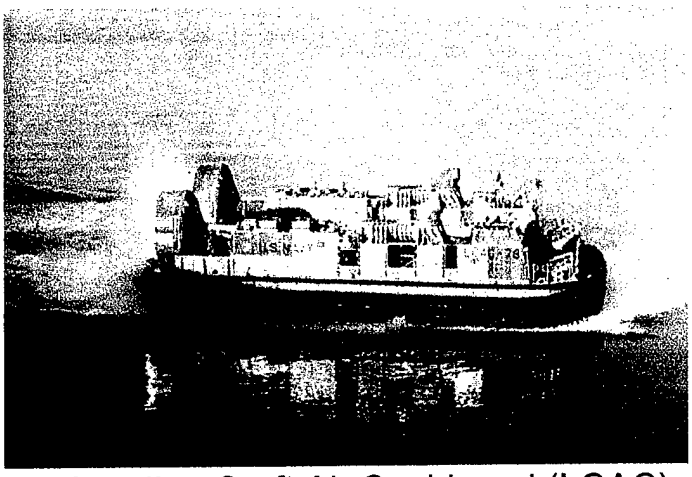
Lighter, Amphibious, Resupply, Cargo Vehicle (LARC)



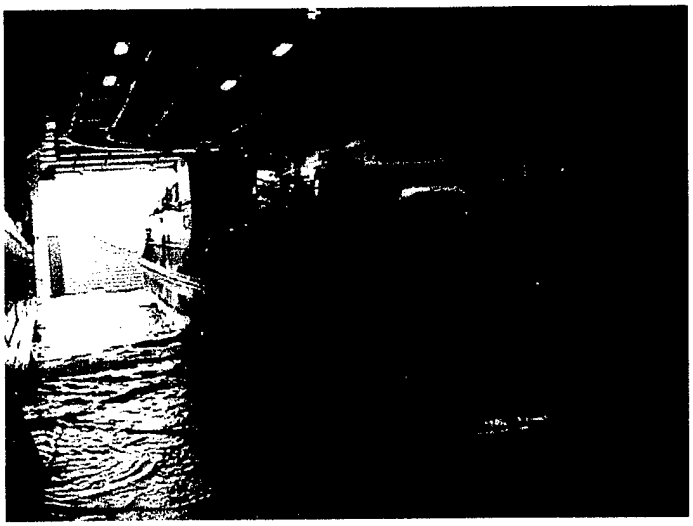
Assault Amphibian Vehicle (AAV)

High Mobility Multipurpose Wheeled Vehicle (HMMWV)

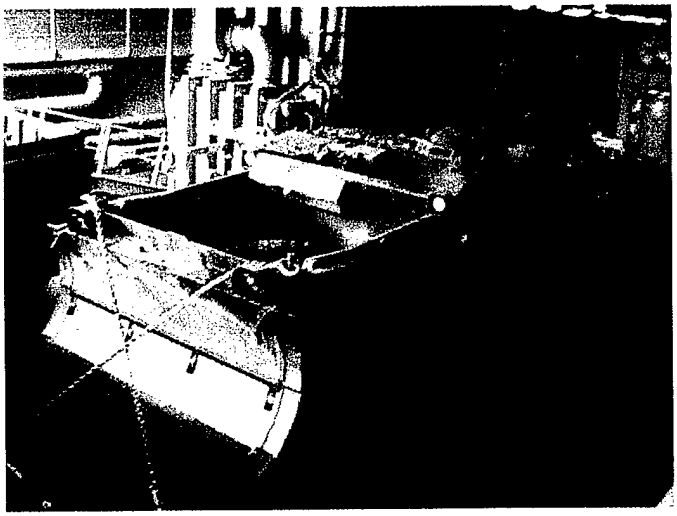
Amphibious Vehicles



Landing Craft Air Cushioned (LCAC)

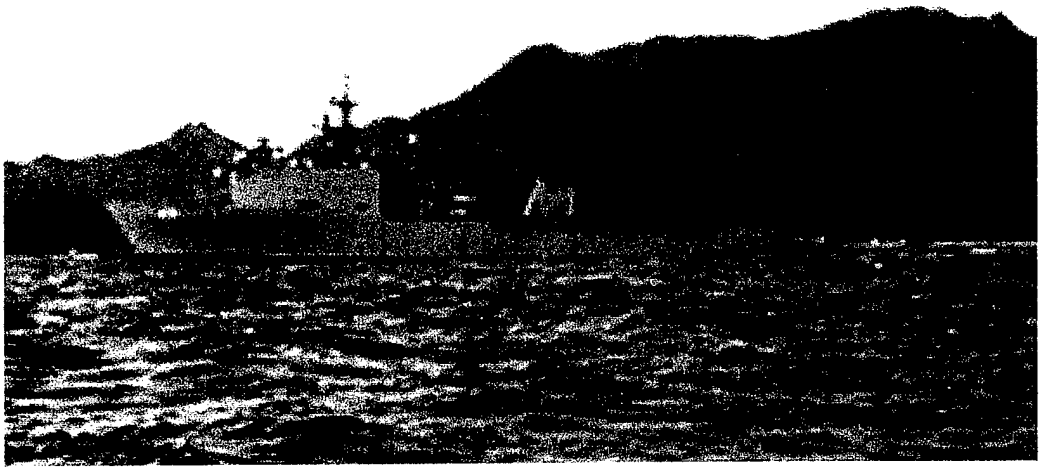


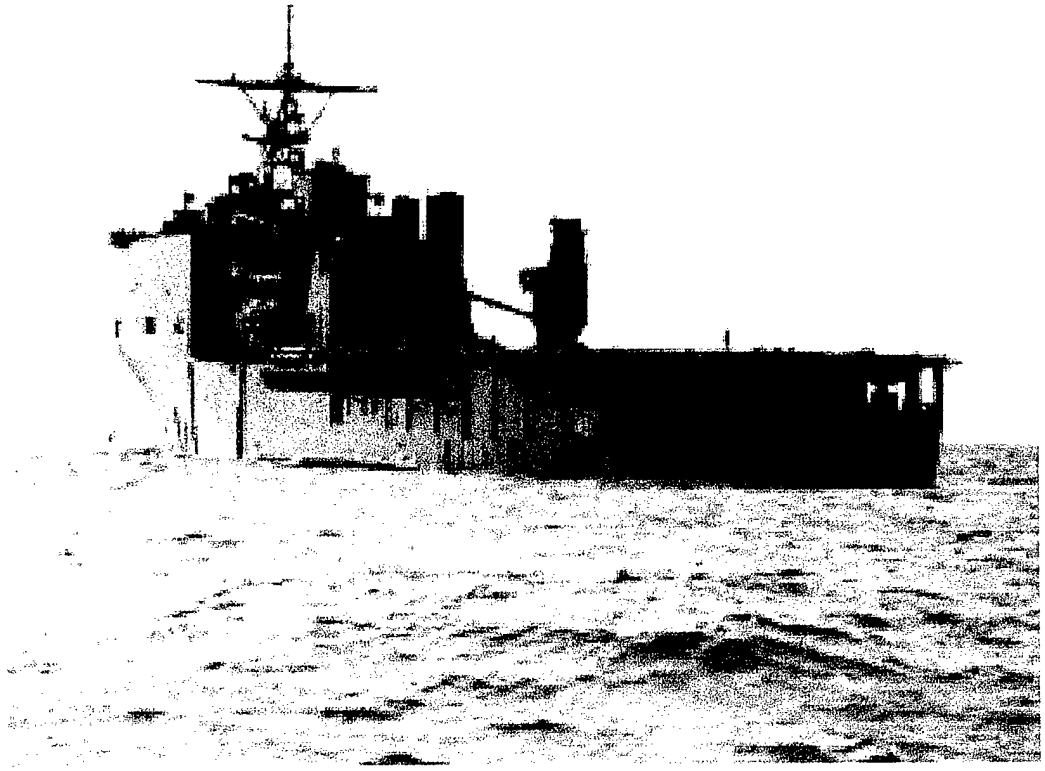
Landing Craft, Utility (LCU)



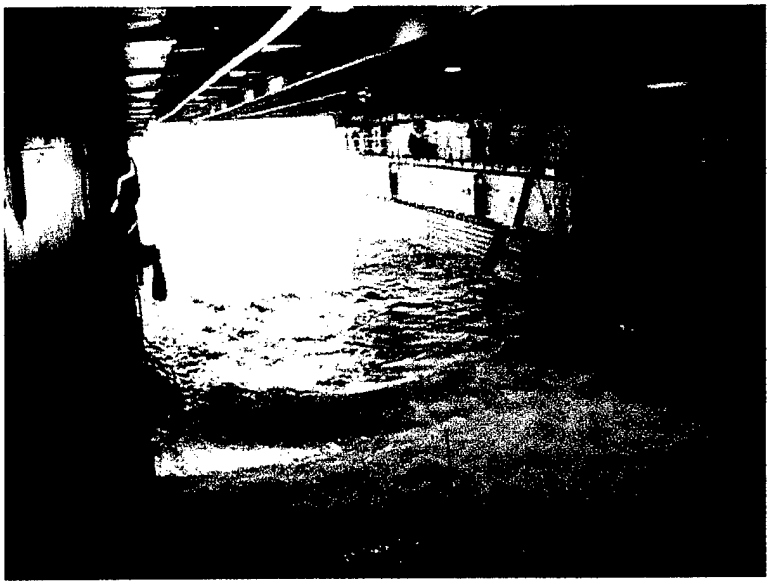
Light Armored Vehicle (LAV)

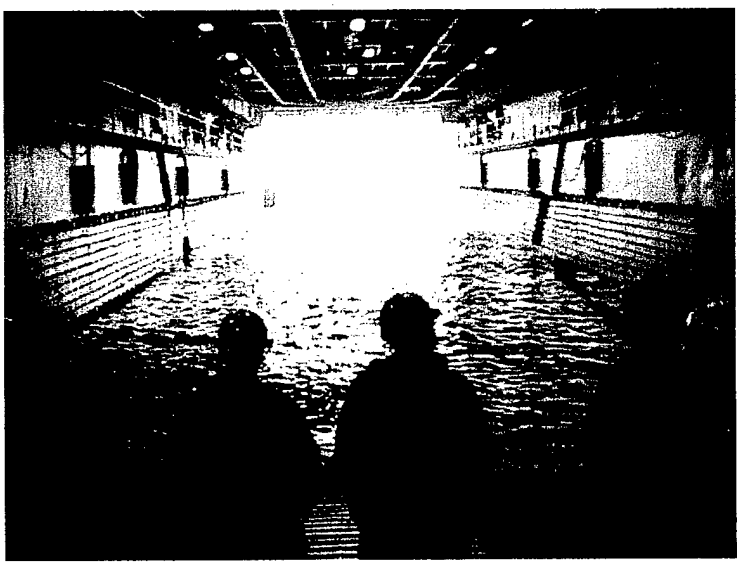
Angle of Ship When Ballasted



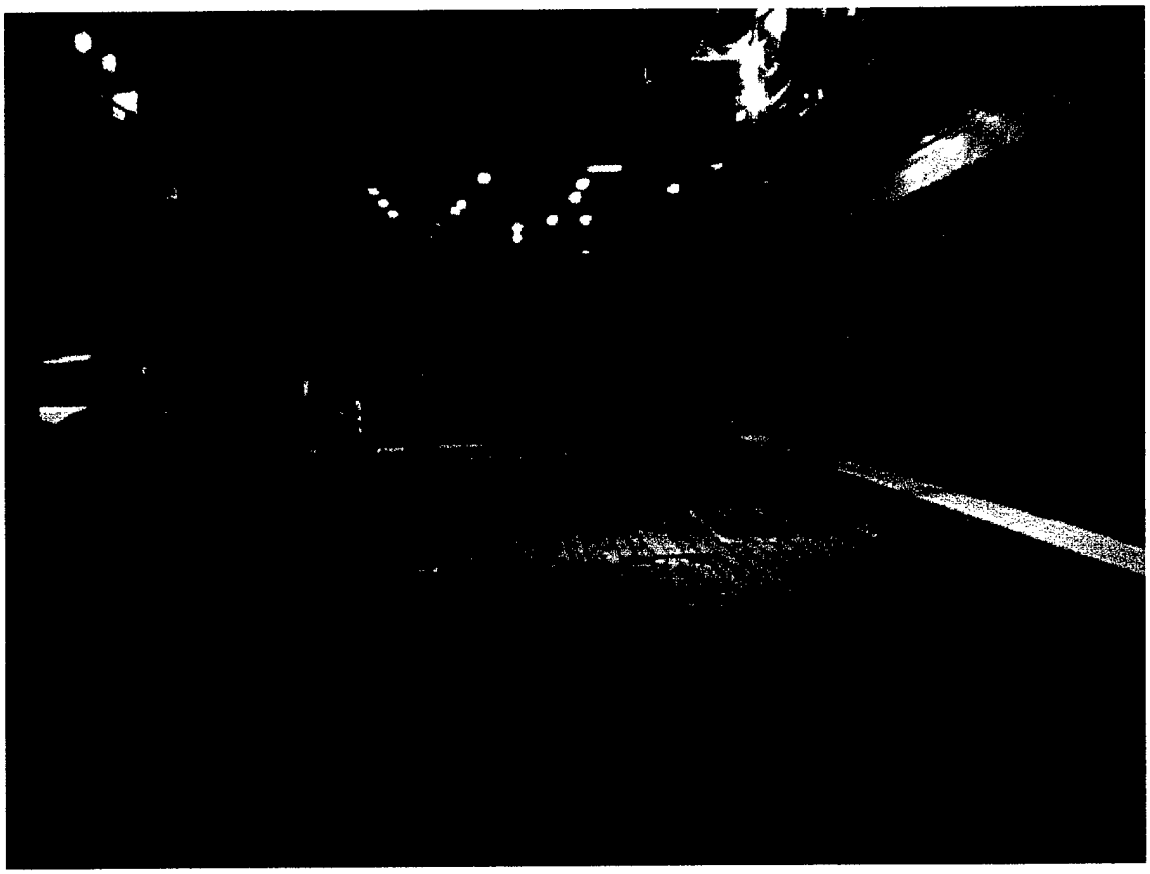


Angle of Welldeck When Ballasted

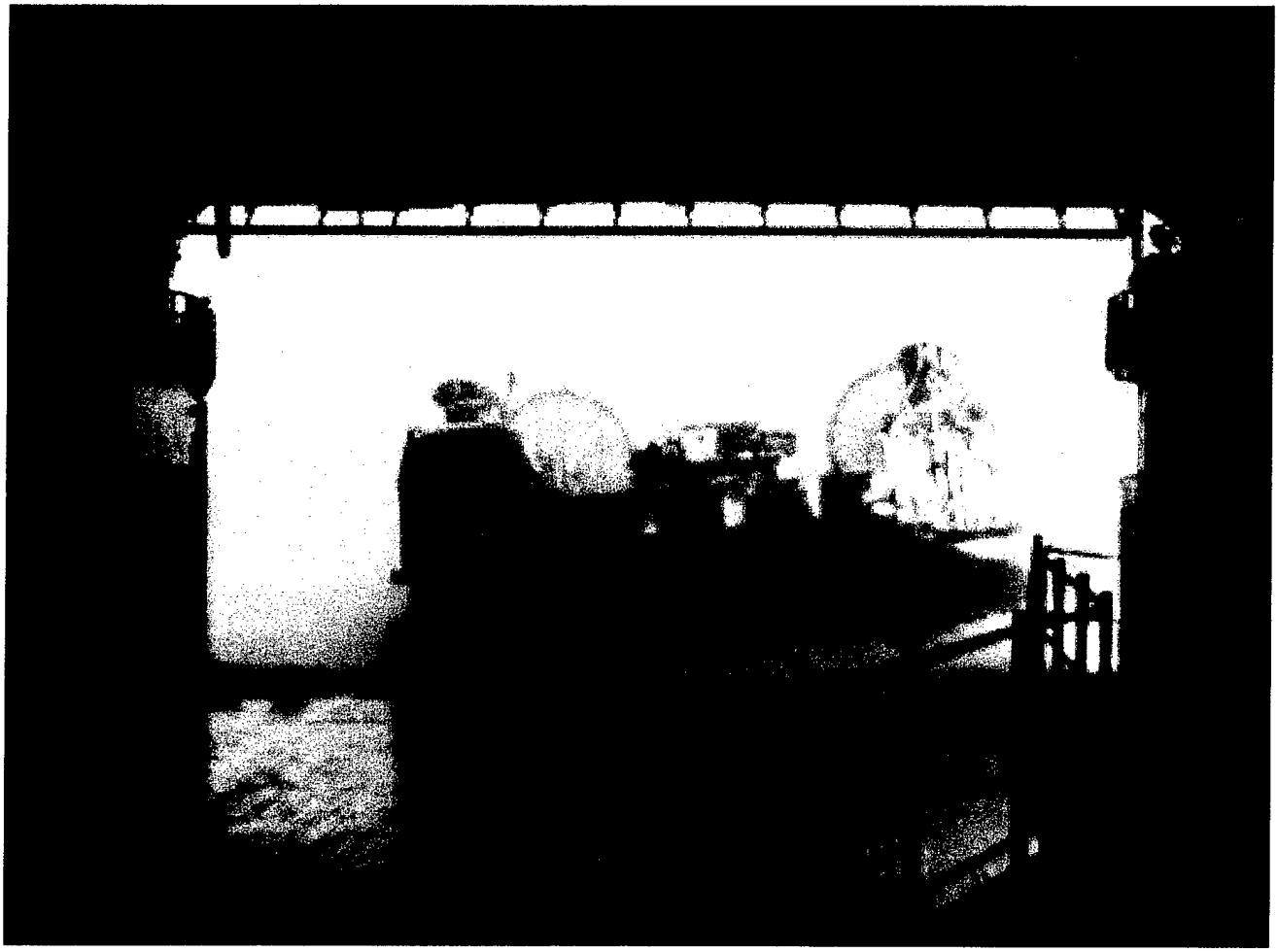




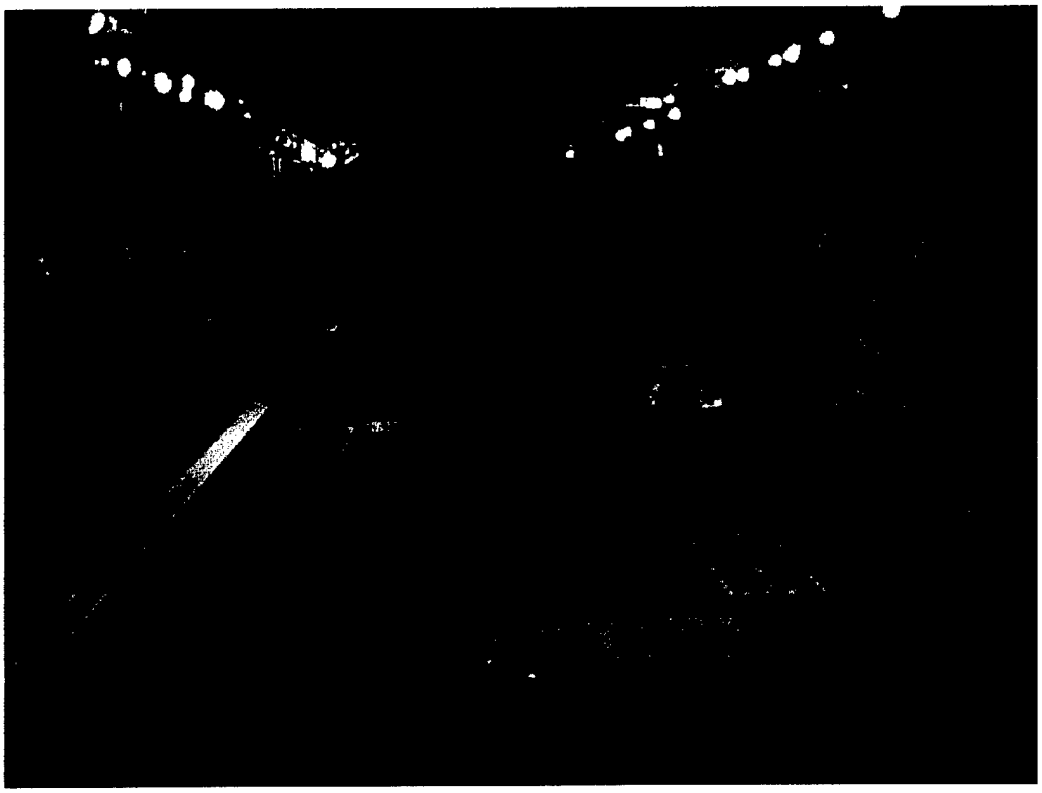
FOD (Foreign Object Damage) Walkdown



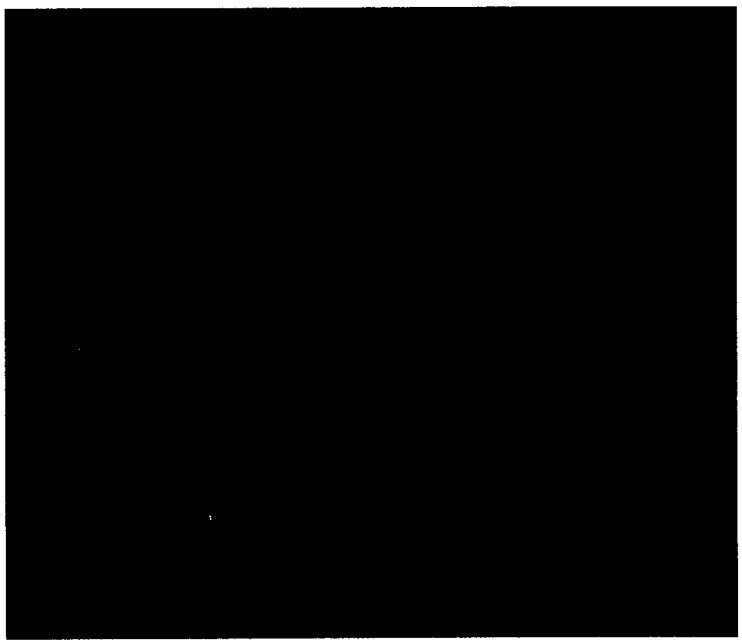
LCAC Entering Welldeck



LHD-1 Class Welldeck



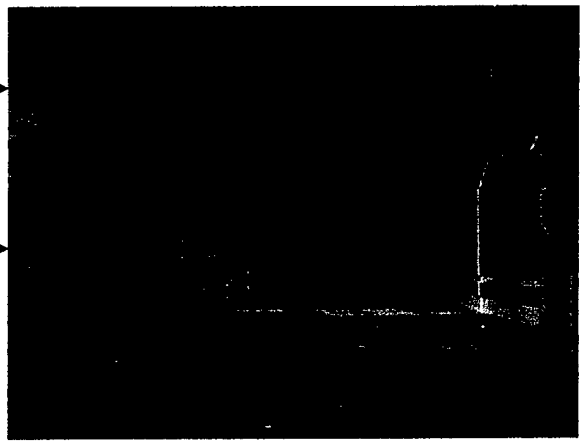
Tie-Down

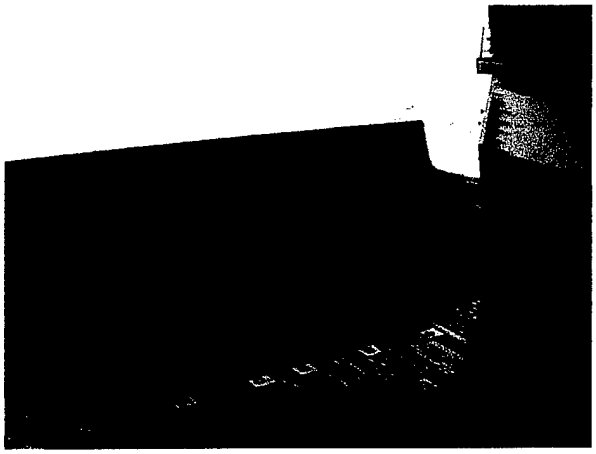


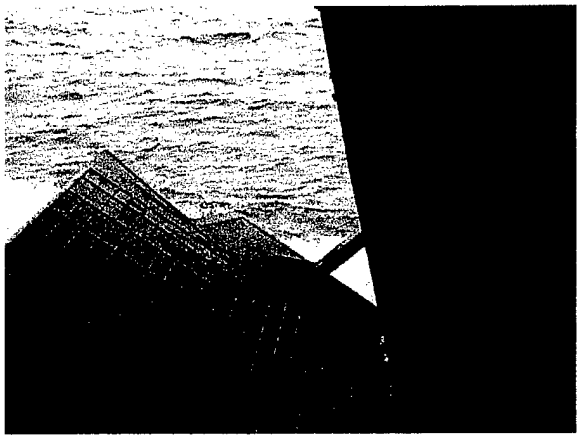
Stern Gate

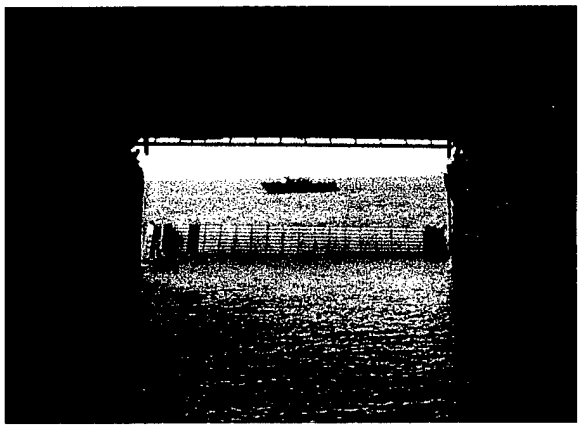
Eyebrow →

Stern Gate →

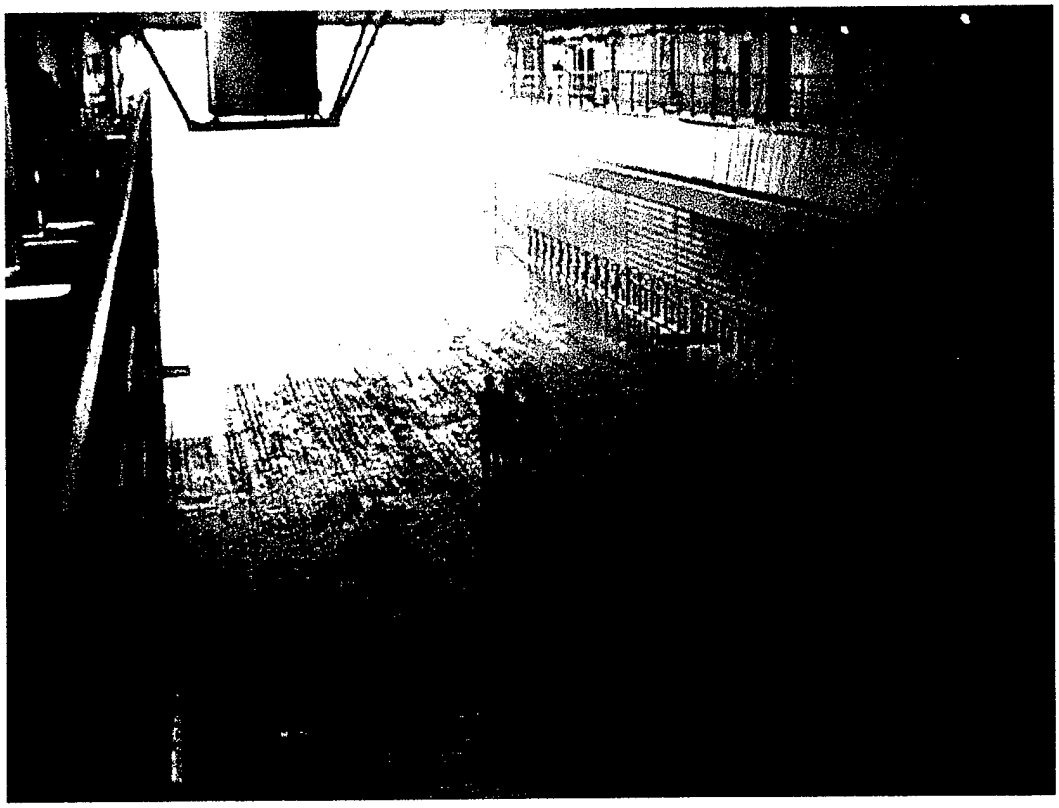




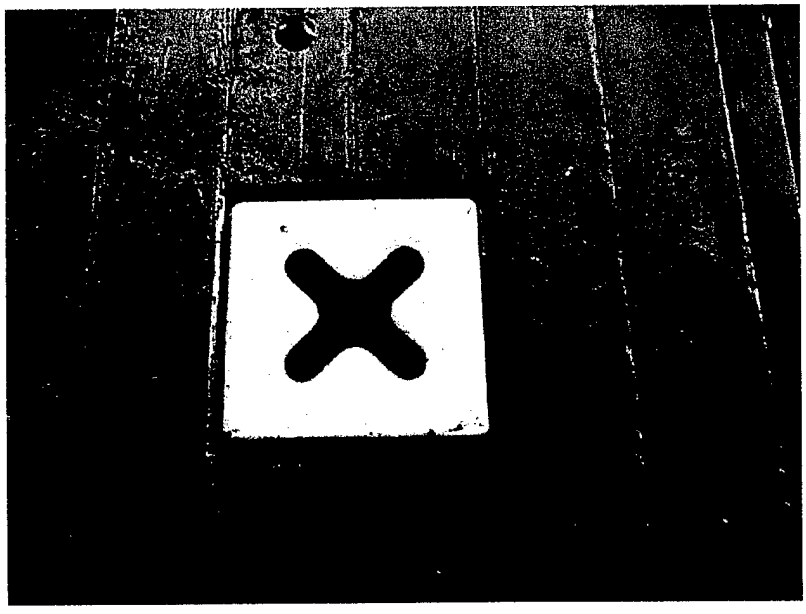




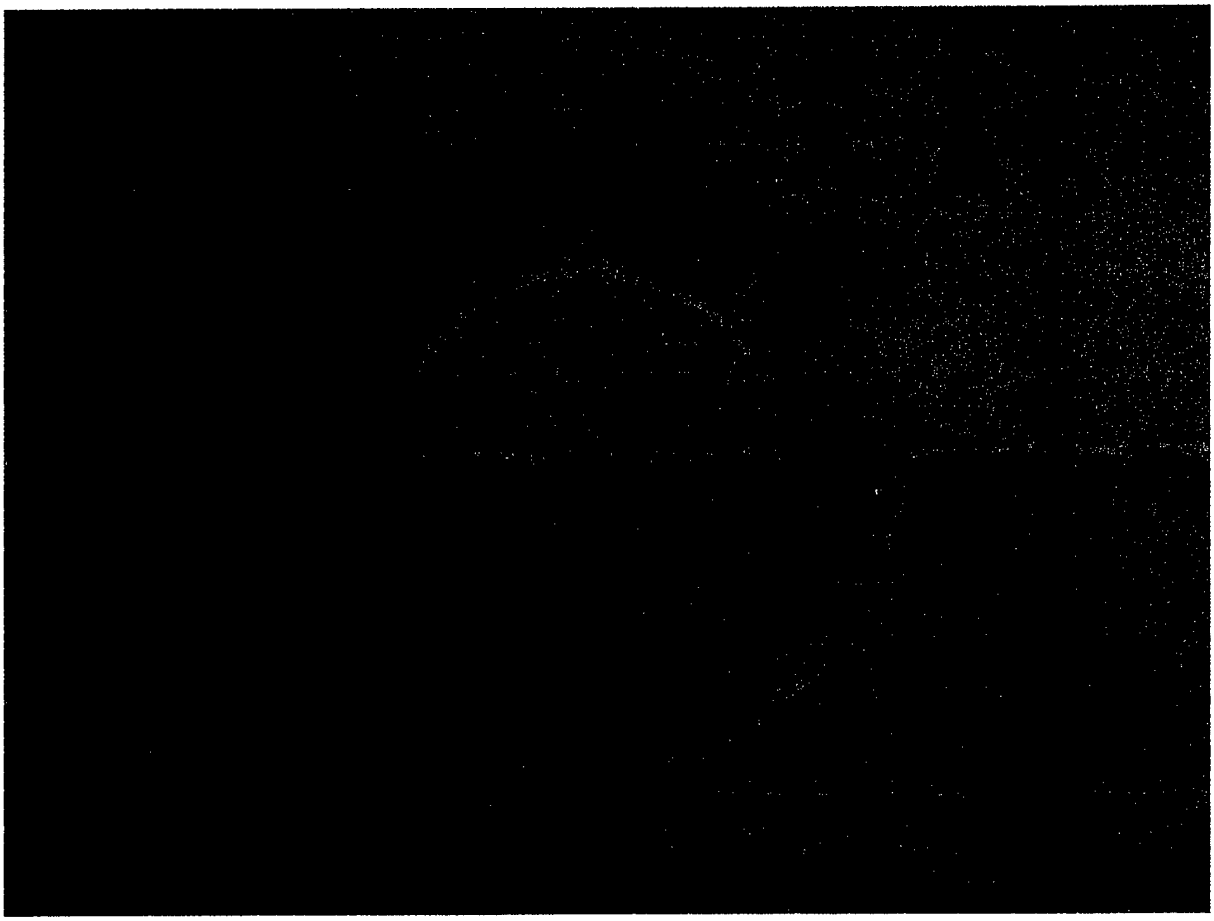
LPD-4 Class Welldeck



Tie-Down



Hose Connection Adapter Installed in Access Cover



LSD-49 Class Welldeck